Electro–Optics Technology, Inc.

Amplified Photodetectors
User Guide

Thank you for purchasing your Amplified Photodetector from EOT. This user guide will help answer any questions you may have regarding the safe use and optimal operation of your Amplified Photodetector.

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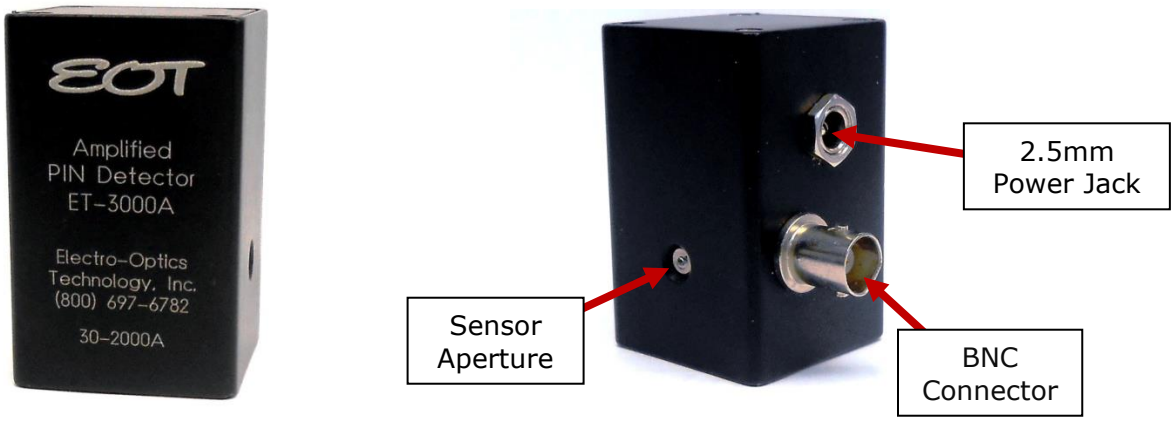
I. Amplified Photodetector Overview

EOT's Amplified Photodetectors contain PIN photodiodes that utilize the photovoltaic effect to convert optical power into an electrical current. Figure 1 below identifies the main elements of your Amplified Photodetector.

Figure 1: EOT Amplified Photodetector



When terminated into 50 Ω into an oscilloscope, the pulsewidth of a laser can be measured. When terminated into a spectrum analyzer, the frequency response of a laser can be measured.

II. Operation of your EOT Amplified Photodetector

A. Caution: Eye safety precautions must be followed when utilizing any equipment used in the vicinity of laser beams. Laser beams may reflect from the surface of the detector or the optical mount and caution must be exercised.

B. Mount the detector to an optical stand by the mounting holes on the bottom of the detector housing. An 8/32 nylon standoff is included to isolate the detector from the optical stand if noise is generated due to grounding through the stand.

C. Adjust the voltage of the oscilloscope to 100 mV/division before connecting the detector.

D. Connect the detector to the oscilloscope using a 50 Ω coaxial cable that one meter or less.

E. Use the 50 Ω termination input of the oscilloscope. If the oscilloscope does not have a 50 Ω input, connect the coaxial cable to a 50 Ω terminator and connect this to the oscilloscope's 1 MΩ input.

F. When possible, use a scatterplate (white paper works) to integrate the laser beam. Focus on the active area only if you need increased sensitivity.

G. If the full bandwidth of the detector is not needed, use low-pass, bandpass, or high-pass filters to remove excess noise.

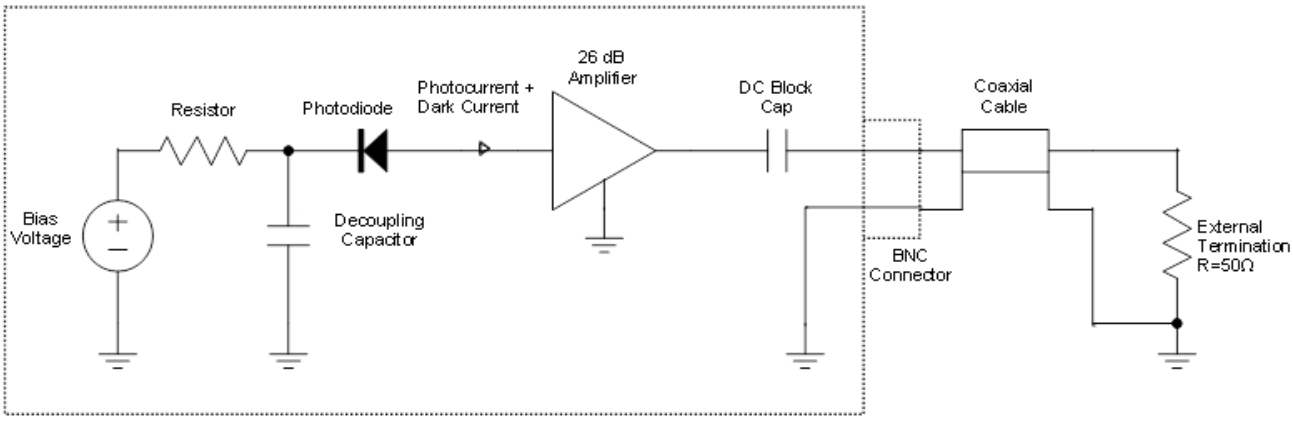
III. Troubleshooting

A. No signal is seen the first time the detector is used.

1. Is the AC power supply plugged in?
2. Is the detector terminated into 50 Ω at the oscilloscope?
3. Is the wavelength of the laser within the spectral range of the detector?
4. Is the signal high off the scale on the oscilloscope?
5. Inspect the diode for possible damage.
6. If increasing the incident power does not result in a higher voltage output, the detector is probably saturated. Check the photodetector's data sheet for the Maximum Linear Rating specification.
7. Are all the connectors securely in place?

8. Is the bandwidth you are trying to measure below the low frequency cutoff of 30 kHz?

IV. Schematics: Amplified Photodetectors



V. Warranty Statement and Repair

EOT warrants its products to be free from defects in material and workmanship and complies with all specifications. EOT will at its option, repair or replace any product or component found to be defective during the warranty period. This warranty applies only to the original purchaser and is not transferrable for a period of one year after date of original shipment. The foregoing warranties shall not apply, and EOT reserves the right to refuse warranty service, should malfunction or failure result from:

a. Damage caused by improper installation, handling or use.
b. Unauthorized product modification or repair.
c. Operation outside the environmental or damage specifications of the product.
d. Contamination not reported to EOT within 30 days of the original ship date.
e. EOT's output isolators contain a "spacer" at the end of the isolator. Under certain conditions, an off-axis back-reflection from the workpiece could focus down onto the output displacer or polarizer inside the isolator. The purpose of the spacer is to eliminate the conditions under which this could happen. Should EOT's output isolators be purchased without the spacer, or should the spacer be removed, damage to the output displacer or polarizer will not be covered under warranty and the customer will be responsible for all costs associated with such an occurrence.

This warranty is exclusive in lieu of all other warranties whether written, oral, or implied. EOT specifically disclaims the implied warranties of merchantability and fitness for a particular purpose. In no event shall EOT be liable for an indirect, incidental, or consequential damages in connection with its products.

If the customer believes there is a problem with the photodetector, they should immediately contact EOT's Sales/Customer department at 231-935-4044 or customerservice@eotech.com. EOT's Customer Service department will either issue an RMA for the device, or provide the customer with a procedure and authorize the

customer to modify the device. All returns should reference the RMA number on the outside of the shipping container and should be sent to:

Electro-Optics Technology, Inc.
Attn: Sales/Customer Service
3340 Parkland Ct.
Traverse City, MI 46986 USA

EOT reserves the right to inspect photodetectors returned under warranty to assess if the problem was caused by a manufacturer defect. If EOT determines the problem is not due to a manufacturer defect, repairs will be done at the customer's expense. EOT will always provide a written quote for repair prior to performing repairs at the customer's expense.

VI. Glossary of Terms

Amplifier: Provides a transimpedance gain throughout the photodiode's bandwidth. The photodiode current is converted to an output voltage.

Bandwidth: Unlike non-amplified photodetector bandwidth, which is defined as the range of frequencies from 0 Hz (DC) to the frequency at which the amplitude decreases by 3 dB, the amplified photodetectors have a low frequency cutoff of -3 dB, which is greater than 0 Hz due to the DC Block Capacitor. Bandwidth and rise time can be approximately related by the equation:
Bandwidth ≈ 0.35/rise time for a Gaussian pulse input.

Bias Voltage: The photodiode's junction capacitance can be modified by applying a reverse voltage. The bias voltage reduces the junction capacitance, which causes the photodiode to have a faster response.

BNC Connector: Used to connect the customer's coaxial cable.

Conversion Gain: The relative level of the optical input power that is amplified and converted into a voltage output.

DC Block Capacitor: Prevents the DC voltage that is supplied through the amplifier output from exiting the detector which would cause a large DC offset voltage. Therefore, the amplified detector is an AC coupled device and will have a low cut-off frequency as well as a high cut-off frequency.

Decoupling Capacitor: Maintains bias voltage when fast pulses cause the battery voltage to reduce (this would slow the response time of the photodiode); the capacitor allows the battery to recover to its initial voltage. It also acts as a low-pass filter for external power supplies.

Noise Equivalent Power (NEP): A function of responsivity and dark current and is the minimum optical power needed for an output signal to noise ratio of 1. Dark current is the current that flows through a reverse biased photodiode even when light is not present, and is typically on the order of nA. Shot noise (Ishot) is a source of noise generated in part by dark current; in the case of reversed biased diodes it is the dominant contributor.

Photodiode: Converts photons into a photocurrent.

Resistor: Part of the low-pass filter at the photodiode cathode.

Responsivity: In amps per watt (A/W), responsivity is the current output of the photodiode for a given input power, and is determined by the diode structure. Responsivity varies with wavelength and diode material.

Rise Time/Fall Time: Rise Time is the time taken by a signal to change from a specified low value to a specified high value. Fall Time is the time taken for the amplitude of a pulse to decrease from a specified value to another specified value. A larger junction capacitance will slow the detector's response time.